The Role of Electromagnetic Pollution in Cancer Promotion

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Abstract

Exposure to non-ionizing electromagnetic frequencies (EMF) that include extremely low frequency electric and magnetic fields, intermediate frequencies commonly referred to as dirty electricity, and both radio frequency and microwave wave radiation has been increasing. Epidemiological studies document an increased risk of cancer incidence and cancer deaths associated with cell phone use, Wi-Fi exposure, as well as living near broadcast antennas, cell phone antennas and power lines. Electromagnetic pollution at levels well below international guidelines has been shown to cause cancers (in vivo studies) and several plausible mechanisms (in vitro studies) have been identified that include, but are not limited to oxidative stress, altered calcium flux, and increased membrane permeability. Time is long overdue for the World Health Organization and governing bodies to establish guidelines that truly protect public health. Also, time it for the medical community to incorporate strategies to deal with the harmful effects of electromagnetic pollution, as part of their medical protocol, and to teach about this concept at medical schools since our exposure is likely to continue to increase.

Introduction

Our exposure to electromagnetic pollution in the form of radio frequency (RF) and microwave (MW) radiation (MHz to GHz frequencies) has been accelerating with our growing reliance on wireless technology. Cell phones and their communication antennas; Wi-Fi routers; Wi-Fi enabled computers, tablets, and ipods; smart meters, smart appliances and smart homes; wireless computer games; wireless baby monitors; and–more recently–light bulbs that can be turned on and off with a cell phone; diapers that send out a wireless alert when they are soiled; and soothers with embedded thermometers that enable a parent to monitor their infant’s temperature remotely using microwave frequencies are just some of the devices that are being developed for our convenience with no regard for health effects. Our exposure to intermediate frequencies (IF) at the lower part of the RF electromagnetic spectrum (kHz frequencies) have also been increasing with our use of electronic technology like computers, TVs, energy efficient light bulbs, solar and wind power. Add these two types of electromagnetic pollutants to extremely low frequency (ELF) electromagnetic fields (EMF) generated by electricity and electric devices and we find ourselves swimming in a sea of electromagnetic soup. Few places exist that are free of these anthropogenic electromagnetic fields (NIR) that do not have enough energy to break chemical bonds. It was assumed to be safe provided that it did not heat the body as microwaves are known to heat tissue, hence the use of microwave ovens to heat food. Consequently, the international guidelines for RFR recommended by International Commission on Non-Ionizing Radiation Protection [3] and accepted by the WHO and many governing bodies around the world, protect only against a heating effect. A few governments have established guidelines that are orders of magnitude lower than thermal guidelines and are based on biological malfunctions in the presence of much lower EM intensities. Thousands of peer-reviewed publications document the harmful biological effects of NIR at levels well below thermal guidelines [4]. The biological consequences of NIR exposure go well beyond cancers as they adversely affect reproduction and contribute to symptoms of electro hypersensitivity [5 @). The evidence that NIR is carcinogenic is based on a combination of epidemiological, in vivo and in vitro studies and covers the range from ELF EMF to MW radiation.

ELF EMF – Childhood Cancers & Residential Exposure

Children living near power lines and transformers have a greater risk of developing various [6].
cancers, the most notable of which is leukemia. This was first reported 
in 1979 in Denver Colorado [6]. The higher the magnetic field 
exposure the greater is the risk of childhood leukemia [7]. Ground 
currents that generate high magnetic fields around indoor water 
pipes, are also associated with childhood leukemia [8,9] reported a 
peak in childhood leukemia associated with residential electrification 
that emerged de novo in the U.K. in the 1920s and slightly later in 
the U.S. A 24% increase in leukemia mortality for children between 
the ages of 2–4 was associated with a 10% increase in homes served 
by electricity [9,10] documented an epigenetic component and an 
interaction between DNA repair genes (XRCC1 Ex9 + 16 A allele) and 
low frequency magnetic field exposure in childhood acute leukemia. 
Authors concluded that power frequency electromagnetic fields as 
low as 0.18µT may inhibit certain DNA repair genes. This supports 
the epidemiological research that shows magnetic field values between 
0.2 to 0.4µT are associated with a doubling of childhood leukemia yet 
guidelines in many countries allow exposures as high as 200µT for 
any 24-hour period.

**ELF EMF – Adult Cancers & Occupational Exposure**

The Bonneville Power Authority in Portland Oregon reviewed the 
research on the biological effects of ELF EMFs [11]. In their chapter 
on cancer, they found 212 studies of which 101 (48%) documented 
adverse biological effects associated with power frequency 
electromagnetic field exposure. Of the 212 studies, 170 studies dealt 
with occupational exposure and 78 (46%) reported an increased risk 
of various types of cancers while 8 studies (5%) showed a beneficial 
effect. The most common cancers were leukemia (41%), brain cancer 
(40%) and breast cancer (35%). Parental occupational exposure was 
also associated with cancer among offspring in 67% of the studies 
cited (8 out of 12 studies).

*In vitro* studies clearly document increased growth in estrogen 
receptor positive breast cancer cells exposed to 1.2µT magnetic field 
[2,12]. While both melatonin and tamoxifen at therapeutic levels can 
reduce the growth of these cells, when combined with magnetic field 
exposure, the beneficial effects of tamoxifen were compromised. This 
has direct relevance for breast cancer patients taking tamoxifen.

**IF – Adult Cancers**

There are relatively few studies on cancer at electromagnetic 
frequencies within the intermediate frequency range (kHz). This 
type of electromagnetic pollution involves high frequency voltage 
transients (HFVT) that flow along electrical wires and is commonly 
called *dirty electricity* [13] reported no significant increase in breast 
cancer (RR 1.3) but a statistically significant increased Risk Ratio 
(RR) for thyroid cancer (RR 13.3), malignant melanoma (RR 9.8), 
and cancer of the uterus (RR 9.2) among teachers in a California 
school who taught in classrooms where the dirty electricity exceeded 
2000 GS units. Dirty electricity is becoming increasingly common. 
More research is needed in this area.

**RFR – Epidemiological Studies**

The evidence that cell phone users have a greater risk of 
developing gliomas, salivary gland tumors, and acoustic neuromas 
is considerable. Studies document statistically significant increased risk 
for ipsilateral tumors that become apparent after 10 years of moderate 
to high cell phone use [14]. For those who started using a cell phone 
before the age of 20, the risk increases significantly [15]. Women who 
keep their cell phones in their bras for 10 years or longer have a greater 
risk of developing multifocal breast cancer near their cell phone [16]. 
People who live within 500 meters of cell phone base stations [17-19] 
and within 3.5 km of broadcast antennas [20-23] have a greater risk 
of developing and dying from various types of tumors.

**Mechanisms**

Several mechanisms have been postulated that provide insight 
into the effects of NIR on living organisms. We have evidence that 
the body is under physiological stress with the production of stress 
proteins [2] that calcium flux is altered leading to a cascade of 
chemical reactions [25]; that membrane permeability especially 
of the blood brain barrier increases allowing toxins to enter tissue 
where they do not belong [26-28]. That levels of free-radicals increase 
in the body due to impaired repair mechanisms [5]; and that DNA is 
damaged [10,14,26]. All of these mechanisms can promote the 
growth of cancer.

**Conclusions**

When epidemiological studies that show an association between 
an agent and an outcome, in this case NIR and various types of 
cancers, are combined with *in vivo* studies that show a cause-effect 
relation between the same agent and cancer and with *in vitro* studies 
that identify the different mechanisms involved (stress protein 
production, increased membrane permeability, altered calcium flux, 
increased free radical content, impaired enzyme activity, etc.), it is 
aive and unscientific to repeat the outdated mantra that, *since NIR 
doesn't have enough energy to break chemical bonds it cannot cause 
cancer* [29]. This is an invalid statement based on a flawed assumption 
and is contrary to scientific evidence. Scientific evidence clearly 
supports the concept that non-ionizing radiation from extremely low 
frequency electromagnetic fields through intermediate frequencies 
(dirty electricity) to microwave radiation contributes to cancer by 
promoting the growth of pre-existing cancer cells and by interfering 
with repair mechanisms leading to an increase in free-radicals and 
DNA damage. This occurs at levels well below international thermal 
guidelines.

It is time for IARC, WHO, and governing bodies to establish 
guidelines that truly protect public health and it is time for the medical 
community to incorporate strategies to deal with the harmful effects 
of electromagnetic pollution as part of their medical protocol and to 
teach about this concept at medical schools, especially since the levels 
of electromagnetic pollution will continue to increase unabated until 
governments and health care authorities take it seriously.
References


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